# Estimating Remaining Useful Life using Data-driven Techniques

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**Abstract:**

Prognostics, here defined as the estimation of remaining useful life given that a fault has occurred, is at the center of systems health management. It gives operators a powerful mechanism in decision making by quantifying how much time is left until subsystem functionality is lost. Typically, damage propagation algorithms rely on physics-based failure mechanisms that attempt to mimic the behavior of the system as a function of system characteristics and different operational and environmental conditions. However, the accuracy of these approaches suffer the presence of a multitude of uncertainty sources. Alternatively, one can employ data-driven approaches when sufficient test data are present that map out the damage space. We are presenting here comparative results from an investigation that explores several data-driven techniques for prognostics. Specifically, we show how Relevance Vector Machine (RVM) and Neural Networks perform on real run-to-failure data. The Bayesian treatment of the kernel-based method in the form of RVM is an elegant way to deal with the uncertainties inherent in data collection. The neural net approximates the coefficients of an exponential damage propagation function in response to different operational stimuli. Results show good agreement with actual remaining life that is competitive with physics-based methods.

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The Prognostics Center of Excellence (PCoE) at NASA Ames Research Center provides an umbrella for prognostic technology development in NASA's health management activities. The PCoE is part of the Diagnostics and Systems Health (DaSH) area in the Intelligent Systems division at NASA Ames. The PCoE is specifically concerned with addressing prognostic technology gaps within the application area of aeronautics and exploration science. The PCoE has approximately 20 supporting members. It has strong affiliations with industry and academia through grants, Space Act Agreements and funded IPP, SBIR, STTR, and NRA projects. It also exchanges information with other government organizations (National labs, DoD, …)

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